

WHAT IS CLAIMED IS:

1 1. A method of designing a phase shift mask, the method
2 comprising:
3 identifying edges of a first phase region of a phase shifting
4 mask, the first phase region being located proximate a critical region and
5 the identified edges not being edges of the first phase region adjacent to
6 the critical region; and
7 defining a boundary phase region along the identified edges
8 of the first phase region.

1 2. The method of claim 1, further comprising:
2 identifying edges of a second phase region of the phase
3 shifting mask, the second phase region being located proximate the
4 critical region and the identified edges not being edges of the second
5 phase region adjacent to the critical region; and
6 defining a second boundary phase region along the identified
7 edges of the second phase region.

1 3. The method of claim 2, further comprising:
2 establishing a boundary around the defined boundary phase
3 region; and
4 assigning area outside of the established boundary to have
5 phase zero.

1 4. The method of claim 2, further comprising generating a trim
2 mask to remove undesired patterns between first and second phase
3 regions.

1 5. The method of claim 3, wherein the first phase region is
2 assigned a phase angle of zero and the second phase angle is assigned a
3 phase angle of 180.

1 6. The method of claim 5, further comprising generating a trim
2 mask to remove undesired patterns between phase 0 and phase 180
3 regions.

1 7. The method of claim 1, further comprising defining a
2 boundary around ends of a second phase region, wherein the ends are not
3 adjacent the critical region.

1 8. The method of claim 1, further comprising defining break
2 locations where phase transitions are most likely to occur.

1 9. The method of claim 8, wherein the break locations have a
2 width that permits patterning and inspection.

1 10. A method of generating phase shifting patterns to improve
2 the patterning of integrated circuit features needing sub-nominal
3 dimensions, the method comprising:

4 defining critical areas;

5 creating phase areas on either side of the critical areas;

6 assigning opposite phase polarities to the phase areas on
7 either side of the critical areas; and

8 constructing a boundary phase region outside of at least one^{of}
9 the edges of the phase areas. 20(8/503)

1 11. The method of claim 10, further comprising:
2 defining break regions where phase transitions are likely to
3 occur;

4 correcting design rule violations; and
5 applying optical proximity and process corrections to phase
6 areas to allow proper pattern generation.

1 12. The method of claim 10, further comprising generating a trim
2 mask to remove undesired patterns between phase areas outside of a
3 desired pattern.

1 13. The method of claim 12, wherein the generating is done by
2 oversizing boundary and break regions.

1 14. A method of enhancing clear field phase shift masks with
2 boundary regions around outside edges of phase 0 and phase 180
3 regions, the method comprising:
4 assigning phase polarities to phase areas, the phase areas
5 including first phase areas and second phase areas;
6 defining edges of the assigned phase areas;
7 defining a first phase boundary region around the defined
8 edges of the first phase area; and
9 defining a second phase boundary region around at least a
10 portion of the defined edges of the second phase area.

1 15. The method of claim 14, wherein defining edges of the
2 assigned phase areas includes defining break regions where phase
3 transitions occur and generating polygons including edges but excluding
4 break regions, wherein the polygons are merged with the assigned phase
5 areas.

1 16. The method of claim 14, further comprising generating a trim
2 mask to remove undesired patterns between the first and second phase
3 areas.

1 17. The method of claim 16, wherein the trim mask does not
2 cover all or any of the second phase boundary region around at least a
3 portion of the second phase area.

1 18. The method of claim 16, wherein the generating is done by
2 oversizing the boundary and break regions.

1 19. A mask configured for use in an integrated circuit
2 manufacturing process, the mask comprising:
3 a critical section defined by first edges of a phase zero region
4 and first edges of a phase 180 region;
5 a first boundary phase region located outside second edges
6 of the phase 180 region, the second edges of the phase 180 region being
7 different than the first edges of the phase 180 region, wherein the first
8 boundary phase region includes an opaque material; and
9 a second boundary phase region around at least a portion of
10 second edges of the phase 0 region, the second edges of the phase 0
11 region being different than the first edges of the phase 0 region.

1 20. The mask of claim 19, further comprising a region outside of
2 defined areas having a phase of zero.

1 21. The mask of claim 19, wherein the second boundary phase
2 region includes an opaque material.